METHYL HYPOBROMITE. CH_3-O-Br.

A solution of 50 g. potassium bromide and 25 g. caustic soda in 25 c. c. methyl alcohol and 250 c. c. water was placed in the condenser previously described, and chlorine passed in as before, but no oil separated.

Methyl hypochlorite was then prepared and distilled into a dilute solution of potassium bromide, which was kept below -8° C. A drop of red oil would form at the end of the delivery tube and sink to the bottom, where it would soon begin to decompose, and then rise to the surface, where it would explode instantly.

It was evident from these experiments that ethyl hypobromite is more stable than methyl hypobromite. One would naturally conclude that the higher members of the series would be still more stable.

AMYL HYPOCHLORITE. $C_5H_{11}-O-Cl$.

Amyl alcohol was shaken up with a solution of 3 g. caustic soda in 300 cc. water, and after allowing the undissolved alcohol to separate the solution was put in the condenser and treated with chlorine. A layer of amyl hypochlorite was obtained. It resembles methyl and ethyl hypochlorites in being a green oil which floats on water and in having a sharp odor more disagreeable than that of chlorine gas, but it is more stable. While I was never able to keep either methyl or ethyl hypochlorites more than four hours, even when kept cold by freezing mixtures, I succeeded in keeping a sample of amyl hypochlorite in an open test-tube 24 hours, at the ordinary laboratory temperature in June. An attempt was made to distill a portion, but when heated to 75° C. it rapidly decomposed, with great evolution of heat and a strong odor of valerianic acid.

AMYL HYPOBROMITE. $C_5H_{11}-O-Br$.

Amyl hypochlorite was shaken up with a cold dilute solution of potassium bromide, and a layer of red oil sank to the bottom. It was washed by running cold distilled water through the vessel containing it, and a portion was then removed by means of a pipette, and weighed, and immediately plunged into dilute ammonia, where it very slowly decomposed. The haloids were precipitated by silver nitrate. 0.1987 g. oil gave 0.1688 g. silver haloids, which lost on heating in chlorine 0.0160 g., indicating that the oil may have been a mixture of amyl hypochlorite, amyl hypobromite and amyl alcohol or decomposition products. A loss of bromine was noticed at the time of transfer for weighing, this having been done in the extremely unfavorable weather of July. I expect to continue these experiments in cold weather, and feel confident that I can prepare alkyl hypobromites entirely free from chlorine, and make perfectly reliable analyses of them. I expect then to study their action on the isocyanides and other unsaturated compounds.

KANSAS MINERAL WATER.

By H. E. DAVIES, Lawrence, Kan.

Presented by E. H. S. Bailey, Lawrence, Kan., and read (by title) January 2, 1897.

Pure water is an artificial product of the laboratory. Natural waters always contain foreign matter in solution and suspension, varying in amount from a mere trace to a very large proportion. The properties, effects and uses of water are considerably modified by these ingredients, and the object in the investigation was to ascertain the chemical composition of some natural waters from different sections of the state.

We may divide all natural waters into four classes:

1. Rain-water.
2. Surface-water, including streams and lakes.
3. Ground-water, including wells.
4. Deep water — water accumulated at considerable depth below the surface, such as artesian wells and springs.

Water containing a large amount of dissolved substances is not considered good for public supply, yet a small amount is considered of value. The presence of substances which ordinarily exist in solution in natural water is not regarded as necessary, because experience has shown that distilled water, properly aerated, is perfectly wholesome. It is, however, true that a person who is in the habit of drinking soft water generally experiences some derangement of the digestive organs on beginning to use distilled water. It has also been proven that the system needs salts of lime for the development of the bones of the body, and that these salts exist in the water; consequently, distilled water would not be so beneficial to the human system as comparatively hard water would be. Surface-waters containing vegetable matter are unhealthy, causing diarrhea, and other diseases, such as malaria and fevers. The most dangerous effects are believed to come from waters polluted with waste materials from large dwellings or sewage of towns and cities.

The "germ theory" of disease is that many diseases are due to the presence and propagation in the system of minute organisms, which are termed bacteria, and that some of the diseases which have their cause in such organisms are malarial fever, typhoid fever, diphtheria, and tuberculosis. Admitting the presence of these organisms in the bodies of persons sick with certain diseases — organisms which, at least in certain stages of their development, can exist outside the human body and retain their vitality for a long time — the question arises how they can find their way into the system of healthy persons to produce disease. The two most obvious of possible carriers of diseases are the air we breathe and the water we drink. Filtering cannot be relied upon in all cases. It has been known to fail utterly in the examination of the most contaminated reservoir water; even the best filters available will not keep back the smallest cell forms, sometimes very abundant. The small protococcus cells have been found in great numbers in waters filtered through sand, silica, or even filter paper. Fortunately, however, these forms are not common in waters. Professor Mallet, in regard to his idea on disease, says:

"If the theory be accepted which has so much in its favor, attributing the production of disease to organic matter in drinking-water — not to say specifically a poisonous substance or substances, but to the presence and actions of organic organisms — it seems quite conceivable that a water containing organic matter of any kind, including vegetable matter, may be harmless at one time, and harmful at another, when perhaps a different stage of fermentation or putrefactive change may have been entered upon and special organisms may have made their appearance or entered upon a new phase of existence. Thus, there might possibly be safety in drinking a peaty water, or water filtered through beds of dead forest leaves, when fresh; danger when, after a certain amount of atmospheric exposure, bacterial organisms had become developed; and safety again, perhaps, after the growth of such organisms had fallen off and more or less of the available organic matter had been consumed."

Though views may differ, we shall be safe in accepting the following summary as given in Nichols on "Water-supply":

1. "A water suitable for domestic supply must be free from all substances

which are known to produce an injurious effect on the human system, or which are suspected with good reason, or on good authority, to produce such an effect.

2. "The water should be, as far as practicable, free from all substances and from all associations which offend the general æsthetic sense of the community, and thus affect the system through the imagination, even if there is good reason to suppose that it is within itself perfectly harmless."

Without doubt the best kind of water for drinking purposes is the moderately soft spring water, without any possibility of contamination by organic matter. Unfortunately, however, such water is hardly ever found in sufficient quantities for the supply of large cities.

WATER ANALYSIS.

Collection of Samples of Water.—The quantity of water which should be collected for analysis should not be less than a gallon, but in case of necessity a smaller amount will do. In collecting water, cleanliness should be insisted upon in all cases; the bottle or jar should be thoroughly washed out with weak sulfuric acid, then thoroughly rinsed with the same kind of water that is to be analyzed, and before collecting the water to be analyzed the collector should satisfy himself with the fact that there is no acidity left in the bottle from the acid used in cleaning it. After the bottle is sealed it should be immediately shipped to the analyst, in order that an examination be made of the substances that are liable to change by standing.

Total Solids.—The determination of total solids is made by evaporating a certain quantity of water in a weighed platinum dish and heating to 130° C. After the water is all driven off, the residue is weighed with the dish; the difference in weight of the dish and of the dish plus the residue gives the amount of total solids in the water.

Chlorine.—Chlorine usually occurs in water in combination with sodium; also, in small quantities with potassium, calcium, and magnesium. The amount of chlorine in water is not of a very great consequence, but the determination of chlorine is resorted to by chemists in order that they may be able to tell whether a certain water is contaminated with organic matter or not.

The determination of chlorine is made by the use of a standardized solution of silver nitrate.

There are some precautions to be guarded against in making this determination: the chromate should be perfectly neutral and free from chlorides; the silver solution and the water should also be perfectly neutral. The reason that acidity should be guarded against is because chromate of silver is soluble in acids.

A special method for the determination of the bases has been prepared by Prof. E. H. S. Bailey, and was used in these examinations. The method, with few additional suggestions obtained by experience in working with the above waters, is as follows: Determination of silica and insoluble residue, and of iron, aluminum, and phosphoric acid.

Silica and Insoluble Residue.—Acidulate one liter of the water with HCl, evaporate to dryness on a water-bath, heat the residue to 110° C, digest the residue with HCl, sufficient quantity to moisten it well, add hot water, and filter; the residue upon the filter is dried, ignited, weighed and calculated as insoluble residue and silica.

Iron, Aluminum, and Phosphoric Acid.—The filtrate from the preceding is treated with ammonium chloride and ammonium hydrate. After heating and allowing to settle, filter and wash. If the precipitate is very large it is redissolved in HCl and precipitated again with ammonium hydrate; the precipitate is then filtered out, dried, ignited and weighed as Al_2O_3, Fe_2O_3, and phosphoric acid.

Determination of Lime.—The filtrate from the above is treated with ammonium oxalate, boiled, allowed to remain in a warm place for several hours, then filtered, washed, and the residue dried, ignited, and weighed either as carbonate or oxide.

Determination of Magnesium.—The filtrate from the above is evaporated to dryness with some nitric acid. If the residue is very large it is redissolved in nitric acid on an iron plate; then the residue is treated with cold water and a drop of HCl; filter if necessary, and add to the solution hydro-di-sodium phosphate and ammonium hydrate and allow the precipitate to stand several hours. The precipitate of ammonium-magnesium phosphate thus obtained is washed with dilute ammonia, and after drying is weighed as magnesium pyrophosphate.

Determination of Sulfuric Acid.—Acidulate one liter of water with HCl, and concentrate to about 200 c. c., add $BaCl_2$ and allow to stand for some time in a warm place. The $BaSO_4$ is weighed as such, and the sulfuric anhydride is calculated from this.

Determination of Na_2O, K_2O, and Li_2O.—The filtrate from the barium sulphate is evaporated to dryness in a platinum dish to remove HCl and separate silica. Digest the residue with a few c. c. of water, and precipitate magnesium without previous filtration by addition of a solution of $Ba(OH)_2$, avoiding a large excess. Enough has been added if a pellicle of barium carbonate forms upon the surface of the liquid on exposure a short time to the air. Filter and wash the usually slight precipitate; heat the filtrate, and add ammonium carbonate, and evaporate the filtrate to dryness, and remove by heating the ammonium chloride completely. Dissolve the sodium chloride in the residue with four or five c. c. of water; warm, and add a few drops of ammonium carbonate and ammonia to separate possible remaining traces of barium, magnesium, and calcium; filter again into a weighed platinum dish, evaporate to dryness, heat nearly to fusion, and weigh the mixed chlorides. Their residue will contain, besides sodium chloride, the potassium chloride, if any is present in the water. If enough alkali is obtained, it may, after weighing, be examined for potassium by ordinary methods.

Determination of Sodium Carbonate.—Evaporate one liter of the water to dryness on a water-bath, treat with water, filter, wash until filtrate no longer shows an alkaline reaction with litmus paper, and titrate the solution with standardized sulfuric acid. The result is calculated to sodium carbonate.

Determination of Bromine and Iodine.—These were determined according to the method as given in the *Journal of the American Chemical Society*, Vol. 18, August, 1896, page 688. This is a modified method, and the writer used it with good success.

A number of waters have been examined by the above methods. The most important of these are the following:

I.

Water from Girard, Kan., used as a source of city supply (parts per 100,000):

SiO_2, etc.	1.75
$Fe_2O_3 + Al_2O_3$	.25
CaO	12.55
MgO	5.70
Na_2O	38.75
Na_2CO_3	1.43
SO_3	30.68
Cl	40.25

CO_2, undetermined.

These constituents are probably combined in the total solid residue, as follows:

SiO_2	1.75
Fe_2O_3	.25
$MgSO_4$	17.115
$CaSO_4$	24.863
Na_2CO_3	1.426
NaCl	66.327
Na_2SO_4	8.245
$CaCO_3$	4.125

II.

OVERBROOK, KAN.—This water was obtained from a well 144 feet deep, but water was reached when the well was dug down to 122 feet. On account of the large amount of salt in the water, vessels become covered with an incrustation when left standing in the water. This well is located 3 miles south and 1½ miles east of Overbrook, in Osage county. There are other wells within a mile of this which are deeper and the water is considerably softer. The constituents, estimated in parts per 100,000, are:

SiO_2 and insoluble residue	5.48
Fe_2O_3 and Al_2O_3	1.72
CaO	60.04
MgO	5.96
Na_2O	211.86
Na_2CO_3	2.85
SO_3	78.72
Cl	242.20
CO_2	undetermined.

In the mineral residue these constituents are probably combined thus (parts per 100,000):

SiO_2	5.48
Fe_2O_3	1.72
$MgSO_4$	17.88
$CaSO_4$	113.028
$CaCO_3$	24.107
Na_2CO_3	2.852
NaCl	399.118

III.

FREDONIA, KAN.—This water comes from a well that was bored for gas and oil, and is a good producer. It is about 700 feet deep. The water is essentially a brine, but it is interesting from the fact that it contains bromides and iodides. (Parts per 100,000.)

SiO_2 and insoluble residue	4.34
Fe_2O_3 and Al_2O_3	8.01
CaO	199.44
MgO	474.06
Na_2O	3746.20
Na_2CO_3	2.61
SO_3	3.14
Cl	4928.50
Br	7.90
I	.84

These constituents are probably combined thus (parts per 100,000):

SiO_2	4.34
Fe_2O_3	8.01
$CaSO_4$	5.338
$CaCl_2$	394.610
$MgCl_2$	1123.465
Na_2CO_3	2.609
NaCl	7051.332
NaBr	10.165
NaI	1.060

IV.

WALTON.—This water is from a well near Walton that has obtained considerable local repute, as being of medicinal value. (Parts per 100,000.)

SiO_2 and insoluble residue	7.40
Fe_2O_3 and Al_2O_3	3.26
CaO	137.00
MgO	10.66
Na_2O	1.41
Na_2CO_3	0.53
SO_3	95.06
Cl	1.98
CO_2	undetermined.

These constituents are probably combined thus (parts per 100,000):

Insoluble residue	7.4
Fe, Al, etc.	3.26
$CaCO_3$	38.84
Na_2CO_3	0.53
$MgSO_4$	31.977
NaCl	2.650
$CaSO_4$	139.123

V.

ST. PAUL.—This water is from a deep well. It is practically a brine. The constituents are as follows (parts per 100,000):

SiO_2 and insoluble residue	1.70
Fe_2O_3 and Al_2O_3	7.10
CaO	65.14
MgO	56.84
Na_2O	1455.54
Na_2CO_3	4.77
SO_3	1.87
Cl	1712.40

CO_2, undetermined.

If properly combined, the results would be (parts per 100,000):

Insoluble residue	1.70
Fe_2O_3, Al, etc	7.10
$CaCO_3$	113.945
$CaSO_4$	3.175
$MgCl_2$	134.701
Na_2CO_3	4.770
NaCl	2742.000

While a good knowledge of the composition of the normal waters of any region is of the greatest value in the interpretation of an analysis, it is claimed "there is no good basis for the establishment of fixed limits for all the various items of analysis below which a water is to be pronounced good and above which it is to be condemned." The value of an analysis, or the opinion of the analyst, about a certain water which has been examined by him, does not depend upon the fullness of his work alone, but also upon the amount of his knowledge concerning the conditions that surround the water. It is not, however, an easy matter to obtain a good knowledge of its surroundings, and on this account the value of the opinion of the analyst is not of so much value. It is better to take the advice of the analyst according to his experience and reputation, rather than to try and obtain an unbiased opinion by withdrawing facts necessary for a satisfactory judgment.

ATCHISON AND NEMAHA COUNTY MINERAL WATERS.

By E. B. KNERR, Atchison, Kan. Read before the Academy January 2, 1897.

The drift in Atchison county is quite uniform in structure, being a heavy compact clay for the most part, with but little gravel and sand intermixed. Water will pass through it very slowly; hence, the wells dug into it are deep, as a rule, usually from 40 to 60 feet in depth; and the water generally stands quite low, though about three feet of water may generally be counted upon in the dryest months. Such wells at those seasons may be easily be pumped dry, but in the course of several hours the water will collect to the depth of a foot or two again. Analysis of this drift water presents nothing of unusual interest.

There are numerous springs in Atchison county. Where these issue from the limestone they are of interest only as furnishing good, cool drinking-water. Several such springs occur within the city limits of Atchison, and have always supplied the neighborhoods in their immediate vicinity with water. One of these springs had for years enjoyed a reputation for medicinal virtues. I was sufficiently interested to make an analysis of its waters, with the following results, which, however, do not reveal, so far as I could discover, any unusual therapeutic qualities (parts per 1,000,000):

NO	Trace
NO_2	79.0
SiO_2	30.0
SO_3	97.0
CO	217.0
Cl	58.0
Basic oxygen	133.0
Fe	6.0
Al	Trace
Ca	156.0
Mg	25.0
K	6.0
Na	111.0
NH_4	Trace
P_2O_5	4.0
Total solids	922.0